Low Voltage Power Supply
High Density Modules
PATRIOT Project Office

A Case Study In

"Modernization Through Spares"

28 May 1997

Low Voltage Power Supply Briefing

(SISD)1538-0597/06

PURPOSE: To Provide Background and Insight On PATRIOT's Low Voltage Power Supply, High Density Module Initiative

Major Themes

- Problem
- Problem ID
- Solution
- Benefits

- Barriers
- Process
- Environments

LVPS
High Density Modules (HDM)

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Concept: **Uses HDM (DC to DC Converters) Building Block Approach to Configure Modules on Mother Board to Meet Varying Low Voltage Power Supply Requirements**

- **Increased Power Generation Efficiency (Reduced Cooling Requirements)**
- **Potential to Double Reliability**
- **Cost Savings (40-50%); Each Module Costs Approximately $250 – $300**
- **Enhanced Logistics – Fix Forward by HDM Replacement**

Applicable To PEO-AMD Programs Requiring Power Conversion

- **PATRIOT**
- **THAAD**
- **Corps SAM**
- **JTAGS**
- **NMD**

Power Supply Concepts

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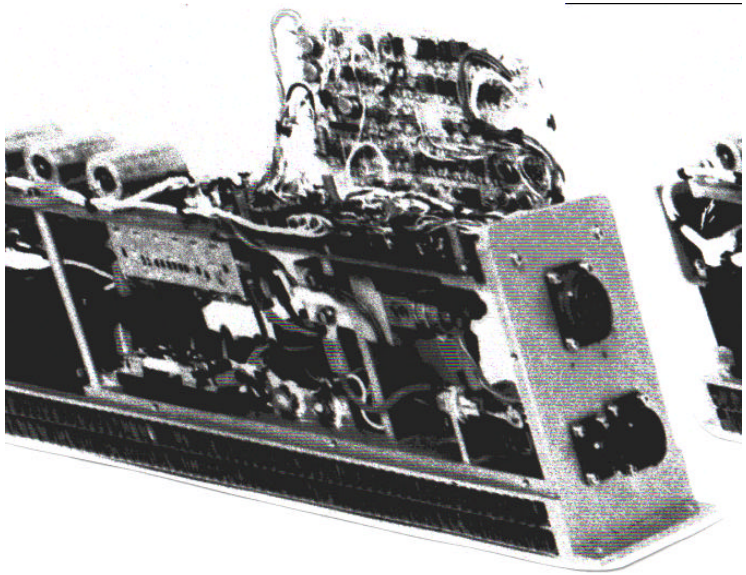
Old Concept

PATRIOT Power Supply – Misc 1



New Concept

Mother Board

Mother Board with HDMs

Low Voltage Power Supply with Heat Dissipater

Digital 3

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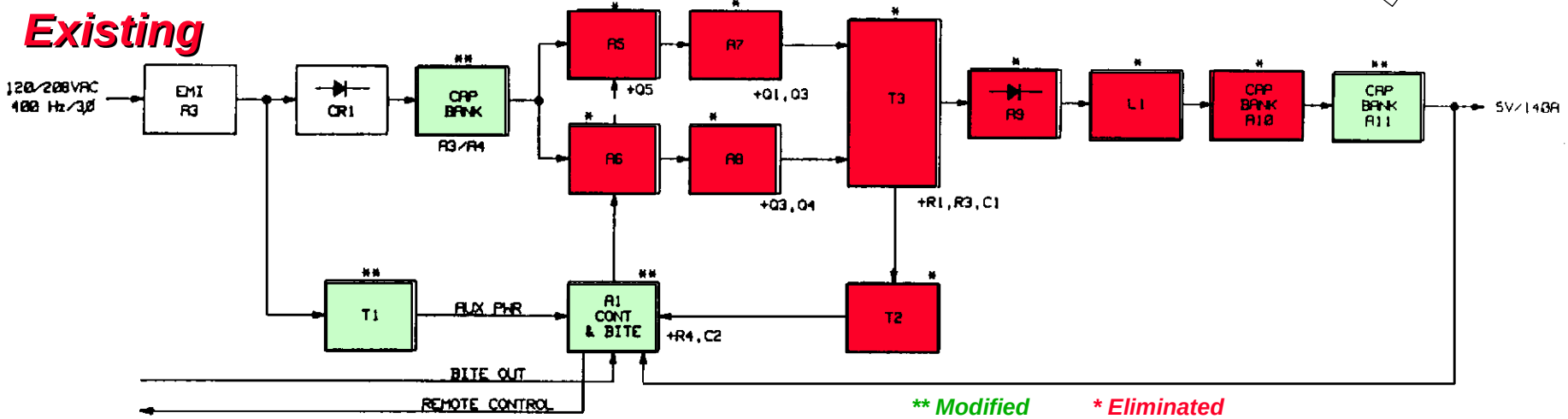
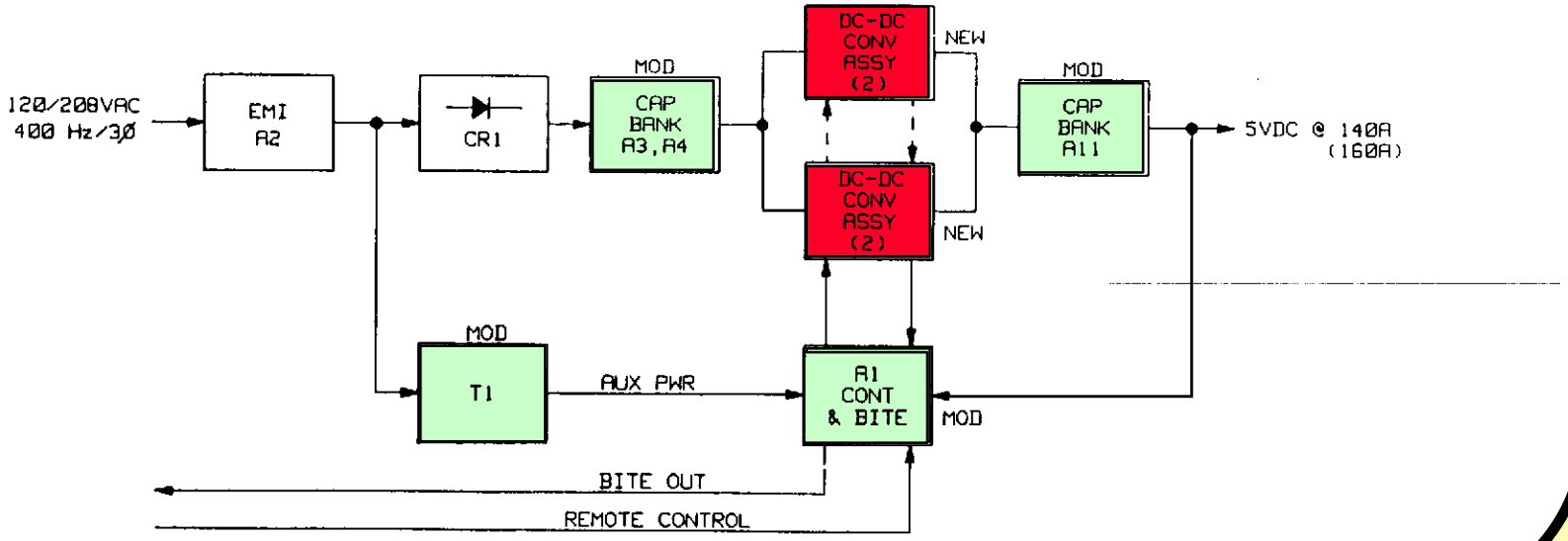
Existing



** Modified * Eliminated

New



New Concept Requires 4 HDM

PAC-2
Low Voltage Power Supply
High Density Module (HDM) Technology

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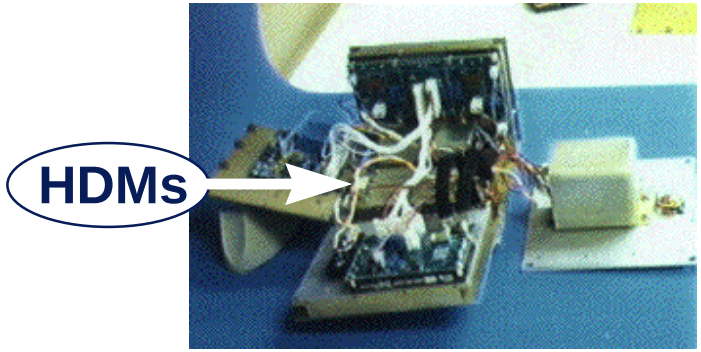
HTI Initiative: Redesigns Four PAC-2 Low Voltage Power Supplies. Configures COTS HDM Modules To Meet Varying Power Requirements.

Old Concept

New Concept



PAC-2 Digital-3 Low Voltage Power Supply

Benefits:

- Increased Power Conversion Efficiency
- Doubled Reliability
  - Mean Time Between Failure Increased From 30,000 to 60,000 Hours
- Graceful Degradation
- BIT/BITE to HDMs
- 10-Year Life Cycle Cost Savings - $10 Million
- Common HDMs Among LVPS and Weapon Systems
- Fix Forward Maintenance With Throw-Away HDMs
- Reduced Spares Pipeline

Validates HDM Technology for Application to Other Systems -- PAC-3, THAAD, MLRS, Corps SAM and Others

Fix Forward Maintenance Upgraded LVPS

U.S. ARMY MISSILE DEFENSE PROGRAM EXECUTIVE OFFICE

PATRIOT

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0035-009/02

OLD

EVAC

COLLECTION POINT

REPAIR BY LVPS REPLACEMENT

EVACUATE FAILED LVPS

REPAIR LVPS

FACTORY

DEPOT

NEW

HDM MODULE

LVPS

REPAIR BY HDM REPLACEMENT

REPAIR

AT FIELD SITE

- ELIMINATE LVPS SPARES PIPELINE
- HIGHER AVAILABILITY OF EQUIPMENT
- HIGH POTENTIAL SAVINGS IN PERSONNEL AND DOLLARS

Organizational PLL Supply

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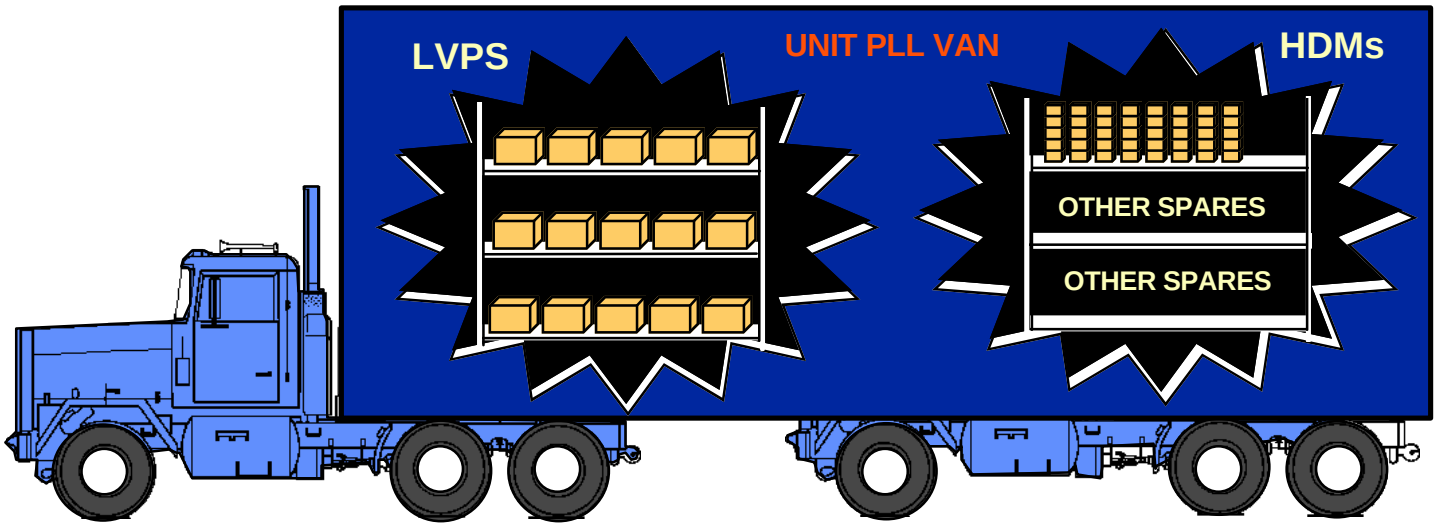
BEFORE

SPARE CHASSIS

AFTER

SPARE MODULES



- HIGH $ INVESTMENT

- LOW $ INVESTMENT
- REDUCED WEIGHT AND VOLUME

HDM Reduces Logistics "TAIL"

HDM Technology Background

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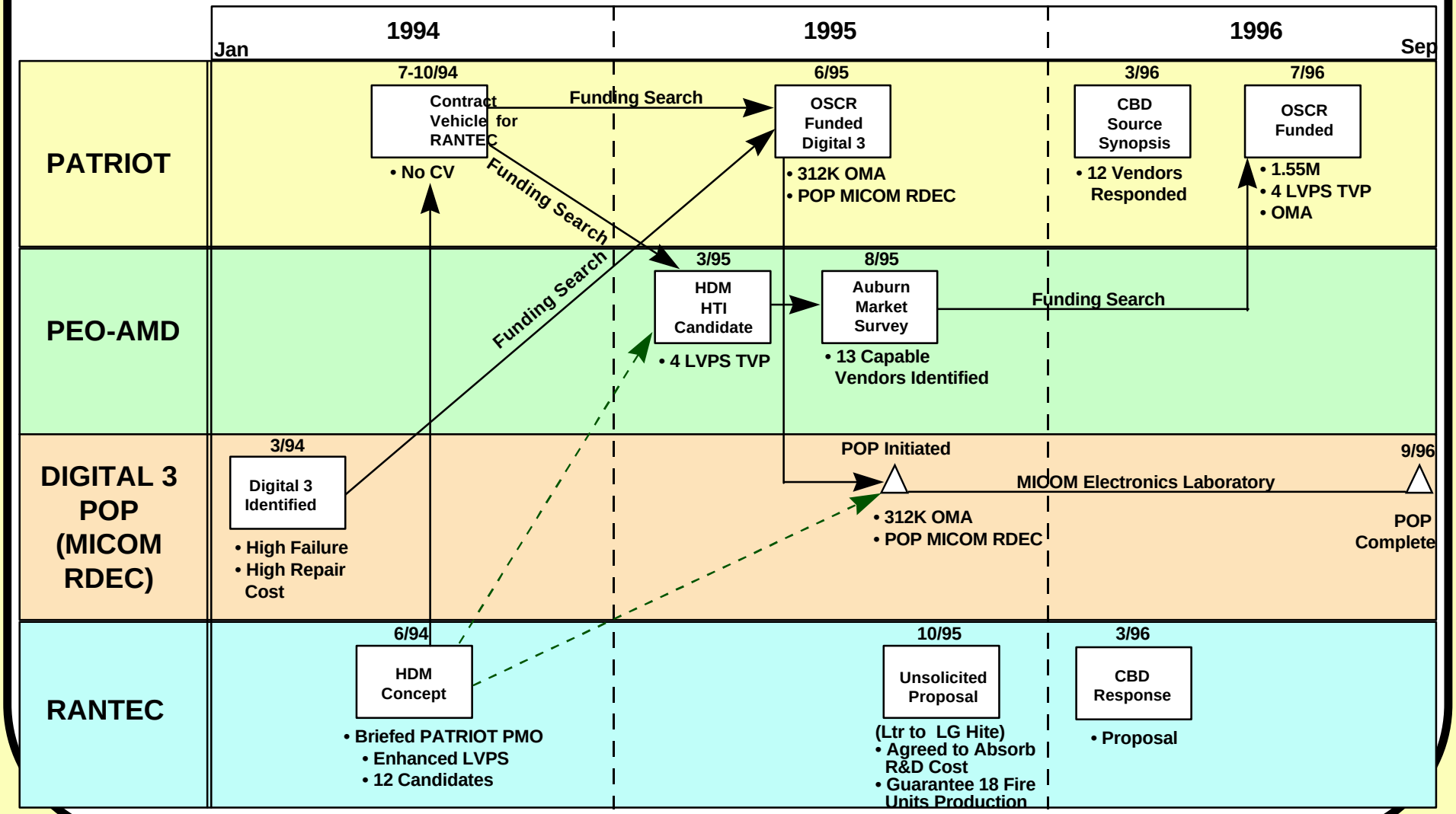

Digital - 3 Enhancement Program

Digital 3 Power Supply Enhancement Program

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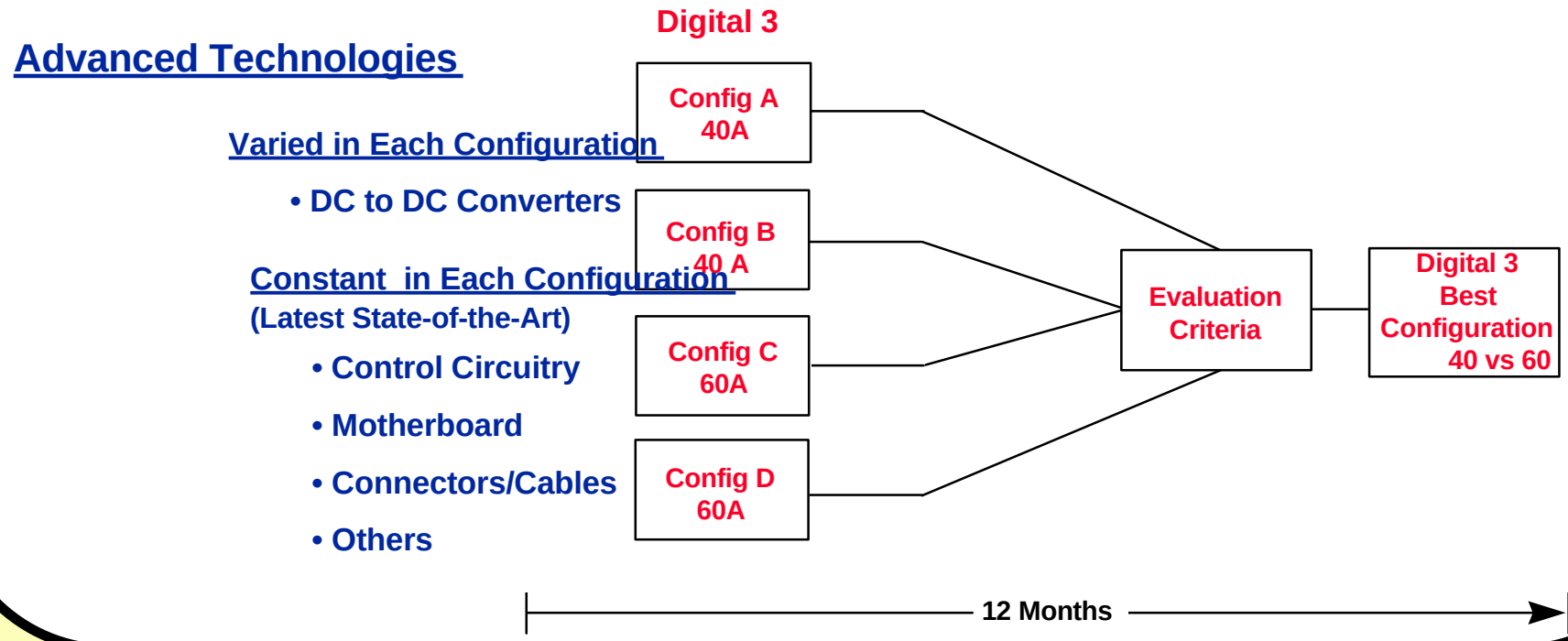
Identified: ***By MICOM as a high failure/high cost O&M driver for assessment and recommended redesign.***

Current Effort : ***MICOM RDEC is designing, fabricating and testing 4 configurations of Digital-3 LVPS. Objective is to determine best configuration from a variety of advanced technologies. Funded by AMC OSCR Program -- $312K -- DBOF-OMA.***



Digital 3 Enhancement Program

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Status

- ✓ • Breadboards of 40A and 60A Configuration Incorporating Advanced Circuitry Enhancements
- ✓ • Preliminary Results Favor 60A Modules
  - > High Power Conversion Efficiency
  - > Current Sharing
  - > Noise and Ripple Rejection
  - > Good Regulation
- ✓ • Bench “Burn-In” Test
- ✓ • Tested in Local National Guard PATRIOT Radar

HDM Market Survey

Auburn University Survey - Summer 1995

- PEO Missile Defense Funded
- Results
  - Surveyed 100 Potential Vendors
  - Identified 13 Vendors That Produce Military-Type DC-DC Converters
  - Identified Additional 33 Vendors That Produce Commercial-Type DC-DC Converters

Sufficient Commercial Capability and Implementation Supports DC-DC Converter Enhancement For Military Power Supplies

LVPS Design Methodology

Status:

- Notified 16 July 1996 That $1.5M Available to Fund TVP (Funds Are DBOF-OMA, Must Be Obligated by 30 September 1996)
- Deciding on Best Alternative
  - -- Alt 1 - Award to Commercial “Power House” to Leverage Expertise of DoD Application
  - -- Alt 2 - Fund MICOM RDEC As Extension of Current Digital-3 Enhancement Program
  - -- Alt 3 - Fund Engineering Services (Raytheon)

RANTEC HDM Proposal

RANTEC Agrees To:

- Design, Breadboard Test, Qualify and System Test -- 4 Types of PATRIOT Power Supplies -- ***NO COST***
- Meet Mutually Agreed-To Power Supply Performance Specifications
- Retrofit 1296 Power Supplies By Installing HDMs, Upgraded Circuitry, LEDs Meeting Current PATRIOT ATP

Government Provides:

- Sufficient Power Supplies (Current Version) For Upgrade

18 Fire Units x 72 Power Supplies/FU = 1296
+ Prototype & System Test + 48
TOTAL 1344

- Guarantee, If Power Supplies Meet Performance Specifications, (Power Savings, Enhanced Reliability) To Fund $7.9 M To Upgrade Eighteen Fire Units ($6,096/Power Supply)

To Be Resolved:

- Program for Retrofit -- Installation, Schedule, LVPS for Rework
- Requirements for Spares -- Module and Reconfigured LVPS

RANTEC Absorbing $1.5 Million in R&D Costs to Have the Opportunity to field Their HDM Technology

RANTEC Unsolicited Proposal Correspondence

(SISD)1538-0597/06

Date	From/To	Subject
13 Oct 95	RANTEC to Hite	RANTEC's Proposal to Absorb R&D Cost
22 Oct 95	Hite to Black	A Note to Work Proposal
17 Nov 95	Black to Hite	PEO/ PATRIOT's Evaluation of Proposal & Acquisition Strategy
27 Nov 95	Hite to Black	Thank You, Responded in 60 Days to DA HTI Office
5 Dec 95	Hite to RANTEC	Thanks for Interest - PEO Evaluating and Will Respond
26 Mar 96	Montgomery to RANTEC	PEO's Response to RANTEC on HDM Proposal Indicating Plan to Go Open Competition If Funds Were Made Available
28 Apr 96	Montgomery to Hite	Status of Actions Taken
2 May 96	Hite to Montgomery	Note on Response Indicating Business As Usual
28 May 96	COL Kuffner to Montgomery	Background Information to Discuss With Hite

12 Companies Responded to the Subject Synopsis in the CBD 16 Feb 1996

PATRIOT
LVPS - Technology Validation Program

LVPS
Technology Validation Program

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Major Tasks:

- Modify 4 Types of PATRIOT LVPS
  - Incorporate HDM Modules
  - Enhanced Monitoring and Control Circuitry
  - Upgrade Sub-Assemblies with Current Technology
- Conduct Bread Board Static Tests
- Mini Qualification Prototype Testing
- Fabricate 32 LVPS for System Test
- Conduct PATRIOT Radar System Test

LVPS Design Methodology

GUIDELINES:

- Uses Old Chassis and Upgrade Internal Components to '90s Technology
- Meets Form, Fit and Function

  (Modification Will Be Transparent to User)
- Provides LEDs to Identify Failed Modules
- Testing Criteria - Existing PATRIOT LVPS Acceptance Test Plans (ATPs)

PAC-3
LVPS - HDM

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STATUS

- Similar TO PAC-2 TVP
  - -- 7 Types of LVPS Which Occupy 21 Positions In The PAC-3 Launcher
  - -- Notified Informally by AMC That FY 96 OSCR Funding Available ($971K)
- Will Become Option to PAC-2 Solicitation

Leverages PAC-2 TVP Effort

HDM
Potential For Army Systems

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EACH SYSTEM HAS LVPS REQUIREMENTS

- Enhanced FOG-M → 6 Power Supplies 80 Fire Units
- Smart-T
- Apache/Long Bow → 381 Systems 10 Modules per System
- Comanche
- MLRS/ATACMS
- Phased Array Antennas
- CSCS
- FAAD → •Avenger •Ground Based Sensor •C⁴I
- Bradley Fighting Vehicle
- Tactical Operation Centers → •AVTOC •ADTOC •FWD PRJ
- Biological Chemical Detection Equipment → 10,000 Modules Detectors
- Avenger
- Black Hawk
- SINCGARS → 254,826 Power Supplies
- J-Stars
- Position Locating System → 2,678 Systems
- Crusader
- Abrams Tanks

HDM Technology Has High Applicability Throughout the Army

Summary

HDM Technology

- Has Many Tangible Benefits
  - -- Doubled Reliability
  - -- Power Conversion Efficiency
  - -- Fix Forward Maintenance Capability
  - -- Lower Production and O&S Costs
- Designate As DA HTI Initiative and Facilitate Integration To All Appropriate Army Systems